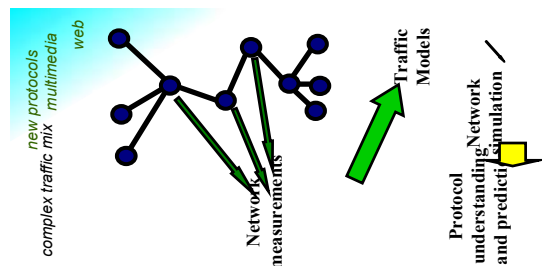


SAMAN: *Simulation Augmented by Measurement and Analysis for Networks*

Project Goals

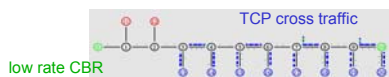
- **Just-in-time model generation**
 - rapid generation of application-level traffic models based on network measurements
- **Analysis-driven failure exploration**
 - Combined analysis and simulation to efficiently explore protocol behavior under stress
- **Failure prediction approaches and tools**
- **Providing a robust simulation environment for network researchers**



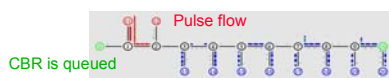
Demonstrate Cascading Failures in ns

- **Goal:** understand, detect, predict, and avoid network cascading failures
- **Current stage:** understand network cascading failures from network traffic perspective
- **Methodology**
 - Reproduce cascading failures under simulation in ns
 - Investigate good metrics to quantify and eventually predict failures
 - Verify simulation results are consistent with network traces
- **Future plans:** implement early warning system to detect and predict network cascading failures

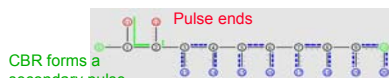
1. Initial state



2. Problem occurs



3. Problem spreads

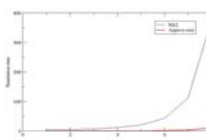
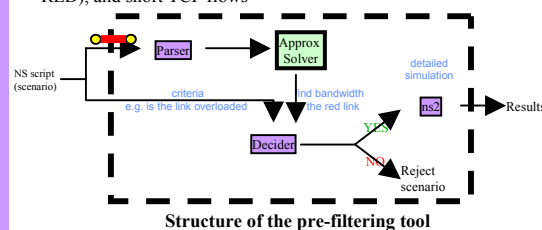


4. Cross-traffic affected

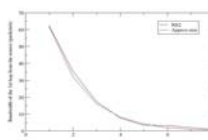


Analytic Scenario Pre-filtering

- **Goal:** study wide design space in reasonable time
- **Problem:** exhaustive exploration of design space with packet level simulation is time consuming
- **Solution:** analytic scenario pre-filtering
 - Developed a pre-filtering addition (approx-sim) to ns
 - Use analytic techniques to rapidly find approximate solution
 - Use simple query language to specify interesting conditions
 - Solve with hybrid queuing theory approach (with TCP-friendly equation)
 - Result is an order of magnitude faster than packet-level simulators
 - But provides approximate answers only (within 10% for symmetric trees)
 - Use tool to select interesting scenarios for detailed simulation
 - Currently prototyped for limited topologies and traffic (bulk TCP)
- **Future plans:** support general topologies, wider range of protocols (e.g. RED), and short TCP flows



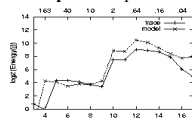
Analytic approx-sim is much faster than packet-level simulation



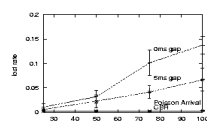
Error between ns and approx-sim

Multi-scale Traffic Modeling and Validation

- **Goal:** demonstrate multi-scale analysis as a tool for validating and debugging traffic model
- **Current status:**
 - Mature RealAudio model
 - Study of model lead to performance improvement with minor protocol change
 - Currently evaluating how to parameterize model from traces
- **Future plans:** rapid multi-protocol model instantiation



Model validation using wavelet scaling analysis



Model suggests minor protocol changes that result in performance improvement

Current Project Members

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- GaTech: Richard Fujimoto, George Riley
- CalTech: John Doyle